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A REVISION OF THE LEAFHOPPERS OF THE MACROSTELES GROUP (CICADULA OF AUTHORS) IN AMERICA NORTH OF MEXICO [1]

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INTRODUCTION

The genus *Cicadula* (auct.) is one of the old European genera that has been recognized in North America for many years and is one of the few old genera of the Cicadellidae that have not been revised in North America. Numerous species have been described in this country in the past 50 years, but no comprehensive list of these species has appeared. In the present revision the genus *Cicadula* is placed in synonymy under *Thamnotettix*, and the species therein contained are

[1] The author wishes to express sincere appreciation to P. B. Lawson of the University of Kansas, to E. D. Ball of the University of Arizona, to the U. S. National Museum, and especially to P. W. Oman of the Bureau of Entomology and Plant Quarantine, for the loan of material and many suggestions; to D. M. DeLong of Ohio State University, for the loan of material and kindly criticism; to Herbert Osborn of Ohio State University, D. A. Wilbur of Kansas State College, and G. Stuart Walley of the Canadian Department of Agriculture, for the loan of material; and to E. W. Davis, assistant entomologist, Bureau of Entomology and Plant Quarantine, for encouragement and helpfulness during this study.

now placed in the genus *Macrosteles*, which has been resurrected, and in the two new genera *Davisonia* and *Sonronius*.

The economic importance of species in this group necessitates their accurate identification. Because of the large number of species involved, their great similarity, the lack of published illustrations, and, in many cases, inadequate descriptions, identification has been uncertain. A revisional study of the classification of the species in this group in North America and foreign countries has therefore been undertaken. In this publication, however, only those from North America are included.

Since the writer has had little opportunity for field observations except in Utah, Arizona, and Nevada, he has relied on other workers for most of the records concerning host plants and habitats.

HISTORY

Zetterstedt (*27*, *col. 296*)[2] in 1840 described the genus *Cicadula* to include 23 species. The original species are now distributed in the genera *Thamnotettix*, *Balclutha*, *Alebra*, *Empoasca*, *Dikraneura*, *Eupteryx*, *Typhlocyba*, and *Cicadula*. The species *C. punctata* Thunb. is now type of the genus *Balclutha*.

The first valid designation of a type for the genus *Cicadula* Zetterstedt appears to have been by Woodworth (*26*), 1888, who named *C. quadrinotata* Fabricius as the type species. The citation of *Cicada sexnotata* Fallén as type of *Cicadula* by Oshanin (*17*, *p. 111*), 1912, and Van Duzee (*24*, *p. 692*), 1917, was in error because of the earlier designation of *quadrinotata* Fab.

Oshanin (*17*, *p. 109*), 1912, designated *T. prasinus* Fallén as type of *Thamnotettix*. *C. quadrinotata*, the type of the genus *Cicadula*, is believed to be congeneric with *T. prasinus*, both belonging to the *Thamnotettix* group. As *Thamnotettix* was described in column 292 of the same publication (*27*) as *Cicadula*, it has page preference over that genus, which is here placed as a synonym of *Thamnotettix*.

Fieber (*4*, *p. 504*), 1866, described the genus *Macrosteles* and included in it *Cicada sexnotata* Fall. and *C. septemnotata* Fall.

Fieber (*4*, *p. 505*), 1866, described the genus *Thamnus* to include the species (*Jassus*) *Thamnotettix confinis* Zett. The first species listed in the genus *Thamnus* was *confinis* Zett., which is hereby designated as the type of that genus. As *confinis* Zett. and *prasinus* Fall. appear to be congeneric, and as *Thamnotettix* has priority over *Thamnus*, the latter becomes a synonym of the former.

Limotettix Sahlberg (*19*), 1871, has often been listed as a synonym (in part) of *Cicadula*, but as fixed by its type, *Cicada striola* Fallén (*3*), 1806, the name is restricted to the group of species formerly placed in *Drylix* Edwards, which is a synonym of *Limotettix*. The first designation of a type for *Limotettix* appears to have been by Haupt (*6*, *p. 25*), 1927.

RELATIONSHIPS

The group of leafhoppers considered in this publication belong to the subfamily Jassinae, which is distinguished from other subfamilies of the family Cicadellidae by the position of the ocelli. In the subfamily Jassinae the ocelli are present on or near the margin of the

[2] Italic numbers in parentheses refer to Literature Cited, p. 22.

vertex and front. The group here considered belongs to the tribe Jassini, which is separated from the other tribes by having the ocelli, if present, on the margin and not distant from the eyes and the nervures of the elytra branching on the disk. The genera here discussed belong to the division Macrostellaria, distinguished by the presence of two anteapical cells in the elytra.

The genus *Macrosteles* is the oldest genus in this division, since *Cicadula* has been removed as a synonym of *Thamnotettix*. The name has been applied as that of a tribe, but it is here used as that of a division.

ECONOMIC IMPORTANCE

The group in this country contains at least one species of economic importance. *Macrosteles divisus* (Uhler) is capable of transmitting the virus disease yellows to celery, lettuce, carrot, parsley, and aster. Severin (*20*, *21*, *22*) has published on the economic relations of this species under the name *sexnotata*. According to him, the lettuce yellows, known as "white-heart" or "rabbit-ear" in New York, and as "Rio Grande disease" in Texas, is a rather serious malady of lettuce, and does thousands of dollars' worth of damage to the celery crops in California. Kunkel (*7*) reported that in many sections of the country aster yellows is "so serious that the planting of asters is being greatly restricted or even abandoned. Aster plots showing 90 to 95 percent of yellowed plants are not uncommon throughout the eastern United States." In the East the direct feeding of this species on oats, timothy, corn, potato, and pasture grass does considerable damage, according to Osborn (*10*, *11*, *12*, *13*, *14*, *15*).

CHARACTERS USED IN THE CLASSIFICATION

The external morphology of the Cicadellidae has been discussed adequately by Lathrop (*8*) and Lawson (*9*). A brief review of the characters found to be of greatest diagnostic value in the genera and species here considered is sufficient for this study.

Generic classification is based on the presence, modification, or absence of caudoventral processes of the external male genitalia, the shape and type of the vertex, and the contour and venation of the elytra. Heretofore the internal male genitalia have not been considered of value as possessing diagnostic generic characters, but the Y-shaped style-aedeagus connective in each genus here included is distinctive because of the relative lengths of arms and stem. In general, the size of any species in this group has been found to be variable. The intensity of coloration is usually unreliable, but the color pattern is constant and sufficiently distinct for specific separation. The best external characters for distinguishing closely related species are the male and female genitalia. The shape of the valve in the males and of the last ventral segment of the females seems to be consistent in each species.

TECHNIQUE USED IN THE STUDY

Methods of preparation and study of sclerotic structures of the male genital chamber have been described by others (*1*, *9*). The specimen is placed on a beeswax block, ventral side up, and the tip

of the abdomen is carefully removed with a sharp needle. This portion is then soaked in cold potassium hydroxide solution for several hours, or in hot solution for about 10 minutes. To heat, the material is placed in a test tube set in boiling water. A 10-percent solution is preferable, as higher concentrations distort the structures.

When sufficiently cleared, the specimen is transferred to distilled water to remove excess potassium hydroxide, and the cleared genital capsule is then transferred to glycerin in hollow-ground slides for study and dissection. The genitalia may be handled with a tiny loop bent in the end of a no. 0 or 00 pin set in a wooden handle.

Illustrations are in outline, stippled to show color pattern.

Drawings are made with a micrometer disk ruled in squares, placed in the ocular of a binocular microscope. The paper is previously ruled with pencil to give the correct coordinate. Enlargements are generally about 10 diameters. Drawings especially show proportional dimensions of different species.

KEY TO GENERA OF THE DIVISION MACROSTELLARIA (KIRKALDY)

Tribe Macrostelini Kirkaldy, Hawaii. Sugar Planters' Assoc. Expt. Sta., Div. Ent. Bull. 1, p. 342, 1906.
Tribe Cicadulini Van Duzee, Amer. Ent. Soc. Trans. 19: 298, 1892.
Division Cicadularia Van Duzee, Catalogue Hemiptera, p. 692, 1917.

a. Wings with four apical cells; elytra with two anteapical and four apical cells (fig. 1, *J*, *K*).
  b. Vertex nearly parallel-margined.
    c. Vertex almost parallel-margined, with no indication of caudoventral process on male pygofer (fig. 1, *A*, *D*, *G*)----*Davisonia*, n. gen., p. 4.
      Type, *Cicadula major* Dorst
    cc. Vertex very slightly produced with small notch on caudoventral male pygofer (fig. 1, *B*, *E*, *H*)----------*Sonronius*, n. gen., p. 9.
      Type, *Cicadula dahlbomi* Zett.
  bb. Vertex distinctly produced.
    c. Vertex produced; with distinct caudoventral process on male pygofer; elytra extending slightly beyond abdomen (fig. 1, *C*, *F*, *I*).
      Macrosteles Fieber, p. 11.
      Type, *Cicada sexnotata* Fall.
    cc. Vertex distinctly angled; elytra long and slender, extending much beyond abdomen---------- *Baldulus* Oman
      Type, *B. montanus* Oman
aa. Wings with three apical cells; elytra with two anteapical cells.
  b. Elytra with three apical cells---------- *Cicadulina* China
    Type, *C. zeae* China
  bb. Elytra with four apical cells.
    c. Head narrower than pronotum; somewhat angularly produced ---------- *Balclutha* Kirk.
      Type, *B. punctata* (Thunb.)
    cc. Head wider than pronotum; very blunt, not produced
      Nesosteles Kirk.
      Type, *N. hebe* Kirk.

The three genera *Davisonia*, *Sonronius*, and *Macrosteles* are considered in this publication (fig. 1).

The Genus DAVISONIA, new genus

Elytra with two anteapical and four apical cells; wing with three apical cells. Resembling *Macrosteles* in wing venation but larger, with extremely broad, short head.

Vertex transverse, almost parallel-margined, broadly rounding to front; front very broad. Clypeus narrowed at apex. Pronotum broad, anterior margin broadly curved. Elytra long and broad, slightly narrowed apically. Caudoventral lobes not present on male

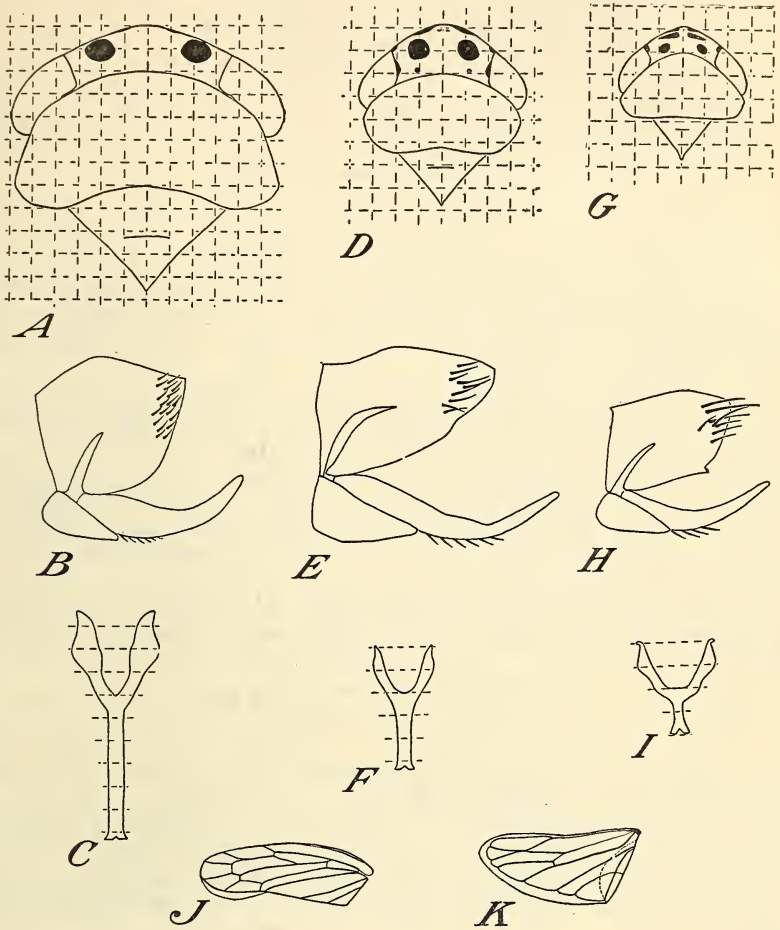

FIGURE 1.—Type species of the three genera *Davisonia, Sonronius,* and *Macrosteles: A,* Head and thorax, *B,* male genitalia, and *C,* connective, male internal genitalia, of species *major,* example of the genus *Davisonia; D,* head and thorax, *E,* male genitalia, and *F,* connective, male internal genitalia of species *dahlbomi,* example of the genus *Sonronius; G,* head and thorax, *H,* male genitalia, and *I,* connective, male internal genitalia, of species *sexnotatus,* example of the genus *Macrosteles; J,* elytra, and *K,* wing of *major,* example of wing venation in the three genera.

pygofers. Stem of connective twice as long as arms on internal male genitalia.

Type of the genus, *Cicadula major* Dorst (*2*), 1931.

This genus is dedicated to E. W. Davis as a slight tribute for the encouragement received in the preparation of this publication.

KEY TO THE SPECIES OF DAVISONIA

a. Vertex almost parallel-margined. Length 4.5–7 mm.
b. Elytra with dark marking, suture of front and clypeus concolorous with sclerites.
c. Generally with two brown spots near apex of vertex. Last ventral segment on female very slightly produced ---------- *major* (Dorst)
cc. Generally with only one brown spot near apex of vertex. Last ventral segment on female strongly produced ---------- *delongi*, n. sp.
bb. Elytra without dark marking. Sutures of front and clypeus black ---------- *punctifrons* (Fall.)
aa. Vertex slightly but distinctly longer at middle than next the eye. Length 4–5 mm ---------- *snowi* (Dorst)

DAVISONIA MAJOR (Dorst)

(Fig. 2, *A, B, C, D, E, F*)

Cicadula major Dorst, Jour. Kans. Ent. Soc. 4: 43, 1931.

Large robust species from 5 to 7 mm long and 1.7 to 2.5 mm wide. Color tawny yellow, with two black spots on vertex, sometimes with two additional black spots on anterior margin, and sometimes with light-gray stripes on elytra.

Vertex nearly parallel-margined, very slightly longer on middle than next to eye, broadly rounding to front. Pronotum with lateral margins distinctly longer than humeral margin.

Male valve large and broad, slightly pointed at apex. Female last ventral segment slightly produced at middle on posterior margin.

Internal male genitalia with foot of style produced to sharp toe; large aedeagus with two curved swordlike processes near apex of shaft; apex of shaft blunt.

Generally collected from *Salix* in New Hampshire, Pennsylvania, Tennessee, Missouri, Kansas, Iowa, Minnesota, Colorado, Utah, and Manitoba.

DAVISONIA DELONGI, new species

(Fig. 2, *G, H, I, J, K, L*)

A large species 4.5 to 5.5 mm long and 1.7 to 1.9 mm wide. Less robust than *major* but less elongate than *punctifrons*.

Color tawny yellow, with two black spots near anterior margin of vertex and an additional brown or black spot at the apex.

Vertex nearly parallel-margined, very slightly longer on middle than next to eye. Pronotum with lateral and humeral margins about equal.

Male valve large. Female with last ventral segment strongly produced on posterior margin.

Internal male genitalia with large aedeagus bluntly pointed, two triangular plates, which are compressed and medially constricted, lying along shaft, to which they are basally attached.

Species named after D. M. DeLong, of Ohio State University.

Collected on *Salix* in Massachusetts, New York, Pennsylvania, Maryland, Virginia, Ohio, Illinois, Wisconsin, Iowa, New Mexico, and Canada.

Holotype and allotype (Baker collection nos. 2220 and 2261) collected at Toronto, Canada, in 1896, by J. C. Crew and C. T. Hill, and deposited in the United States National Museum (Cat. no. 51878).

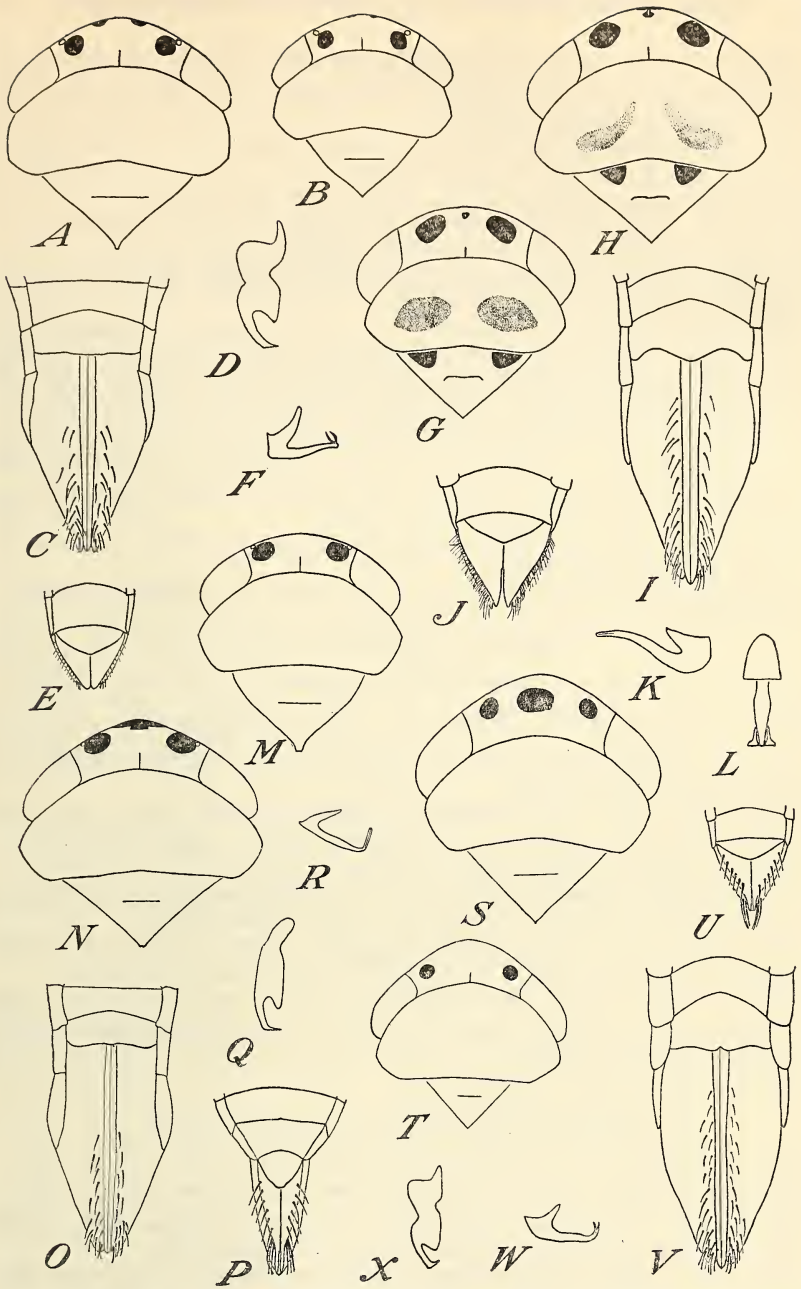

FIGURE 2.—External and internal details of *Davisonia* spp.: *A*, Female head and thorax, *B*, male head and thorax, *C*, female genitalia, *D*, style, internal male genitalia, *E*, male genitalia, and *F*, aedeagus, internal male genitalia, of *D. major*; *G*, male head and thorax, *H*, female head and thorax, *I*, female genitalia, *J*, male genitalia, *K*, aedeagus, internal male genitalia (lateral view), and *L*, same (dorsal view), of *D. delongi*; *M*, male head and thorax, *N*, female head and thorax, *O*, female genitalia, *P*, male genitalia, *Q*, style, internal male genitalia, and *R*, aedeagus, internal male genitalia, of *D. punctifrons*; *S*, female head and thorax, *T*, male head and thorax, *U*, male genitalia, *V*, female genitalia, *W*, aedeagus, internal male genitalia, and *X*, style, internal male genitalia, of *D. snowi*.

Paratypes deposited in collections of D. M. DeLong of Ohio State University, E. D. Ball of Arizona University, the United States National Museum, and the author.

Specimens collected as follows have been designated as paratypes:

Illinois: Algonquin, one female, July 20, 1895.
Iowa: Ames, one male and one female, July 9, 1897, W. Newell.
Maryland: Plummers Island, one female, August 7, 1904, R. P. Currie.
Massachusetts: Chicopee, one female, July 15, 1896.
New York: Lancaster, three females, July 1, 1886, E. P. Van Duzee.
Ohio: Bridgeport, two females, August 30, 1915; Columbus, one female; Milan, one male and one female.
Pennsylvania: Conewago, one female, July 1, 1886, J. G. Sanders; Duncannon, one female, June 24, 1917; Harrisburg, two males and two females, June 29, 1917, H. B. Kirk; Hummelsin, one female, June 29, 1919; Laporte, two males and three females, July 1929, J. N. Knull; North Bloomingfield, two females, June 17, 1922, F. M. Trimble; Sharpsville, one male and one female, June 3, 1925, O. Cartwright; Speeceville, one male and one female, June 14, 1919, J. G. Sanders; Williamsport, eight females, June 13, 1918, J. G. Sanders.
Tennessee: Bells, one female, June 16, 1915; Paris, one female, June 16, 1915.
Virginia: Great Falls, one female, July 18, 1907.
Wisconsin: Augusta, one female, August 4, 1916, D. M. DeLong; one female, West Fairfield, June 1920.
Canada: Toronto, one male, 1896, C. F. Baker and J. C. Crew (Baker collection no. 2220).

DAVISONIA PUNCTIFRONS (Fallén)

(Fig. 2, *M, N, O, P, Q, R*)

Cicada punctifrons (Fallén), Hemip. Suec., Cicad., p. 42, 1826.

A large species 4.5 to 6.5 mm long and 1.7 to 1.9 mm wide, but more elongate than *major*.

Greenish-yellow species with two black spots on vertex and additional dark-brown spot on apex, often with pair of indentations on posterior margin. Elytra dirty yellow.

Vertex nearly parallel-margined, very slightly longer on middle than next to eye. Pronotum with lateral margins short.

Male valve shape of equilateral triangle. Female with last ventral segment slightly produced at ovipositor on posterior margin.

Internal male genitalia with sharp toe on foot of style; large aedeagus, that terminates apically in two fingerlike processes equal to one-third total length.

Collected on *Salix* in New York.

DAVISONIA PUNCTIFRONS VAR. REPLETA (Fieber)

Cicada punctifrons var. *repleta* Fieber, Rev. Ent. 4: 49, 1885.
Cicadula punctifrons var. *amcricana* Van Duzee, Canad. Ent. 23: 169, 1891.

Smaller and paler than the typical form, with angles of scutellum black. Agreeing with *punctifrons* in genital characters.

In all the collections examined no specimens of this variety were found.

The variety *americana* was put into synonymy with *repleta* by Van Duzee (*24, p. 693*). In his original description he stated that this variety agrees with the parent form in genital characters.

DAVISONIA SNOWI (Dorst)

(Fig. 2, *S, T, U, V, W, X*)

Cicadula snowi Dorst, Jour. Kans. Ent. Soc. 4:41, 1931.

Species about 4 to 5 mm long and 1.5 to 1.8 mm wide. Not so robust as *major*.

A yellow species with two spots on vertex but with elytra whitish hyaline, nervures light, and face yellow.

Vertex bluntly angulate, one-fourth to one-fifth longer on middle than next to eye. Pronotum with lateral margins distinctly shorter than humeral margin.

Male valve large and rounding. Female with last ventral segment produced on posterior margin with V-shaped notch at middle.

Internal male genitalia with aedeagus moderately long, terminating in two short fingerlike processes, compressed dorsoventrally and ending in sharp points.

Collected on *Salix* in Wisconsin, Nebraska, Kansas, Montana, and Colorado.

The Genus SONRONIUS, new genus

Same as *Davisonia* and *Macrosteles* in wing venation. Differing from *Davisonia* by a more rounding vertex and from *Macrosteles* by a less produced vertex.

Vertex roundingly produced. Slight notch on caudoventral male pygofer. Connective in internal male genitalia with stem one and one-half times length of arms.

Type of the genus, *Cicadula dahlbomi* Zett. (*27*), 1840.

KEY TO THE SPECIES OF SONRONIUS

a. Nervures of elytra brown or greenish.
  b. Pronotum with markings ..... *dahlbomi* (Zett.)
  bb. Pronotum without markings ..... *clavatus* (DeL. and Dav.)[2]
aa. Nervures of elytra light or cream colored ..... *arcuatus* (G. and B.)

SONRONIUS DAHLBOMI (Zetterstedt)

(Fig. 3, *G, H, I, J, K, L*)

Cicadula dahlbomi Zetterstedt, Ins. Lapp., col. 297, 1840.
Jassus laetus Uhler, U. S. Dept. Int., Geol. and Geogr. Surv. Bull. 1: 360, 1876.
Eutettix vanduzei Gillette and Baker, Colo. Agr. Expt. Sta. Bull. 31: 103, 1895.

A rather elongate species 5 to 6 mm in length and 1.2 to 1.3 mm in width. Allied to *arcuatus* but with six spots on the vertex.

Color tawny yellow with two large black spots on middle of vertex, black elongate spots on anterior margin, two small spots on posterior margin, and a broad black line along inner margin of eye. Pronotum with two black spots on anterior part. Scutellum with markings including two black indentations. Elytra smoky with dark nervures, some specimens without smoky elytra, variable.

Vertex roundingly produced.

Male valve with blunt apex. Female last ventral segment slightly emarginate on middle third.

[2] No specimens of this species have been examined.

Internal male genitalia with blunt toe on foot of style; with long aedeagus terminating in two short, parallel, fingerlike processes, which are compressed dorsoventrally but with distinct inward curve near apex on each.

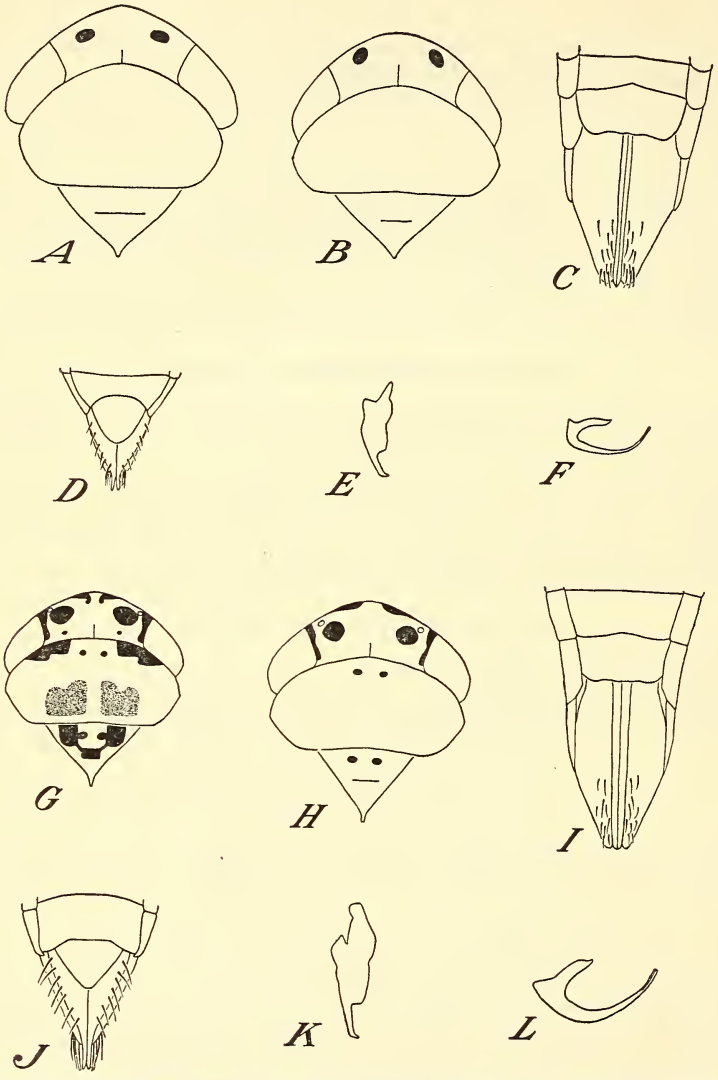

FIGURE 3.—External and internal details of *Sonronius* spp.: *A*, Female head and thorax, *B*, male head and thorax, *C*, female genitalia, *D*, male genitalia, *E*, style, internal male genitalia, and *F*, aedeagus, internal male genitalia, of *S. arcuatus*; *G*, male head and thorax, *H*, female head and thorax, *I*, female genitalia, *J*, male genitalia, *K*, style, internal male genitalia, and *L*, aedeagus, internal male genitalia, of *S. dahlbomi*.

European specimens of *Cicadula dahlbomi* have been examined and found to agree exactly with North American specimens previously known as *laetus*, in shape, coloration, and external and internal male genitalia.

Specimens of *Eutettix vanduzei* appear to be merely dark forms of *dahlbomi*.

Collected in Colorado, Utah, California, Quebec, and Alberta.

SONRONIUS CLAVATUS (DeLong and Davidson)

Cicadula clavata DeLong and Davidson, Jour. N. Y. Ent. Soc. 42: 223, 1934.

(Original description copied.)

Resembling *variata* in form but with distinct color markings. Length 4 mm. Vertex bluntly produced, twice as wide as long, pronotum almost twice as long as vertex.

Color: Golden yellow, vertex with a pair of large round, black spots just above margin. Pronotum unmarked. Scutellum with an impressed dark transverse line across middle. Elytra with clavus dark brown, apical third, frequently extending anterior to apex of clavus, dark smoky to brown. Face yellow, antennal sockets black or dark brown.

Genitalia: Female last ventral segment with posterior margin roundly produced, almost truncate. Male valve strongly produced and rounded, plates triangular, produced into elongated, upturned apices.

Collected in New Jersey.

No specimens of this species have been examined.

SONRONIUS ARCUATUS (Gillette and Baker)

(Fig. 3, *A, B, C, D, E, F*)

Cicadula arcuata Gillette and Baker, Colo. Agr. Expt. Sta. Bull. 31: 105, 1895.

Relatively small species, 4 to 5 mm in length, 1.1 to 1.3 mm in width, but somewhat robust.

Yellow or yellowish green with two black spots, generally with black arc on pronotum. Sutures on front black. Elytra whitish hyaline, often smoky on basal two-thirds.

Vertex bluntly angulate.

Male valve with rounding apex. Female with last ventral segment large, slightly emarginate on posterior margin.

Internal male genitalia with somewhat blunt toe on foot of style; aedeagus with large shaft terminating in two small processes which are about one-fifth total length and laterally compressed.

Collected in Massachusetts, Colorado, Utah, Quebec, Ontario, British Columbia, Alberta, and Saskatchewan.

Note: The species *Cicadula maidis* DeLong and Wolcott (*25*) has been placed by Oman (*16*) in the genus *Baldulus*, for the following reasons: Resemblance of wing venation, elongate body, and vertex triangularly produced and rounding to the front. However, it resembles the species of the genus *Sonronius* in the following characters: Wing venation, roundingly produced vertex, slight notch on caudoventral male pygofer, and connective in internal male genitalia with stem one and one-half times length of arms.

The Genus MACROSTELES Fieber

Cicadula Zetterstedt (in part), Ins. Lapp., col. 296, 1840.
Macrosteles Fieber, Verhandl. Zool. Bot.-Gesell. Wien 16: 504, 1866.
Limotettix Sahlberg (in part), Notiser ur Sallsk. 12: 247, 1871.

In general the members of this genus are small and rather elongate. Vertex longer on middle than next the eye but not strongly pro-

duced. Pronotum short; anterior margin more or less convex; posterior margin generally slightly concave. Elytra long, exceeding the abdomen, overlapping apically, with a distinct appendix, two anteapical cells, and four apical cells. Hind wings with three closed apical cells. External male genitalia characterized by elongation of plates in two attenuated fingerlike processes; male pygofers with distinct caudoventral processes. Internal male genitalia with aedeagus having two processes apically; connective with stem about equal to arms in length.

Type of the genus, *Cicada sexnotata* Fall. (*3*), 1806.

KEY TO THE SPECIES OF MACROSTELES

a. Species more than 3.2 mm in length.
  b. Vertex with black spots.
    c. Vertex with four or less black spots on anterior margin.
      d. Vertex with two angular black spots near posterior border and two angular black spots on anterior margin which extends down to front.
        e. Without additional black spot near each eye---*variatus* (Fall.)
        ee. With additional black spot near each eye---*lepidus* (Van D.)
      dd. Vertex with two or less black spots on anterior margin.
        e. Elytra subhyaline, nervures light, scutellum yellow.
          f. Vertex with two black spots on anterior margin *binotatus* (Sahlb.)
          ff. Vertex without distinct black spot on anterior margin *ungae* (Ashm.)
        ee. Elytra spotted to darkly clouded.
          f. Pronotum not solid black---*borealis* (Dorst)
          ff. Pronotum solid black---*osborni* (Dorst)
    cc. Vertex with three pairs of spots in two rows.
      d. Spots on vertex distinct.
        e. Pronotum not distinctly marked with black.
          f. Elytra marked with fuscous streaks---*fascifrons* (Stål)[3]
          ff. Elytra not marked with fuscous streaks---*divisus* (Jhl.)
        ee. Pronotum distinctly marked with black---*lineatifrons* (Stål)[3]
      dd. Spots on vertex convergent---*slossoni* (Van D.)
  bb. Vertex without black spots.
    c. Front without prominent black markings.
      d. Venter distinctly darkened---*pallidus* (Osb.)
      dd. Venter distinctly yellow, spots if present small and brown *obsoletus* (Dorst)
    cc. Front with prominent black markings.
      d. With black band on front---*viridi-griseus* (Edw.)
      dd. With two distinct black spots on front---*wilburi*, n. sp.
aa. Species less than 2.7 mm in length.
  b. Vertex with spots convergent or entirely black in males---*potorius* (Ball)
  bb. Vertex with six or more distinct spots---*scriptus* (DeL.)

MACROSTELES VARIATUS (Fallén)

(Fig. 4, *A, B, C, D, E, F*)

Cicada variata Fallén, K. Svenska Vetensk. Akad. Nya Handl. 27: 34, 1806.
Jassus fumatus Herrich-Schaeffer, Fauna Germ., fasc. 153, 5, 1838.

A rather elongate species 5 to 6 mm in length, 1 to 1.2 mm in width; allied to *lepidus* but with four large spots on vertex.

Vertex somewhat angular in front. Yellow or yellowish green, with two large black spots on anterior margin and two large black

[3] No specimens of this species have been examined.

spots near posterior margin of vertex. Basal angles of scutellum generally black. Elytra whitish hyaline, often smoky.

Male valve elongate. Female last ventral segment with distinct V in middle of posterior margin.

Internal male genitalia with large foot and sharp toe on style, with large aedeagus terminating in two fingerlike processes equal to one-half length of shaft, lying nearly parallel along shaft.

Species varying a great deal in size and coloration, but larger than *lepidus*. Some with elytra having blotches of black, often with small spot between ocelli and eye.

Collected on grass from Maine, New Hampshire, Connecticut, New York, New Jersey, Pennsylvania, Ohio, Wisconsin, Kansas, Tennessee, Colorado, New Mexico, Utah, Quebec, Manitoba, and Ontario.

MACROSTELES LEPIDUS (Van Duzee)

(Fig. 4, *G, H, I, J, K, L*)

Cicadula lepida Van Duzee, Canad. Ent. 26: 139, 1894.

A species that resembles *divisus* but with four spots on vertex and with one additional spot near each eye. Vertex more angulately produced than in *variatus*. Length 4 to 5 mm, width 0.9 to 1 mm.

Vertex obtusely angulate. Yellow or yellowish green, with two large black spots near posterior margin of vertex and two large black spots on anterior margin. A spot on each side between ocelli and compound eye. Elytra whitish hyaline, often smoky on basal two-thirds.

Male valve large and rounding. Female last ventral segment emarginate on middle of posterior margin.

Internal male genitalia with style medium-sized, foot with teeth, toe not sharp, with large aedeagus terminating in two fingerlike processes, one-third length of shaft, armed with teeth on terminal third.

Collected on low swampy grass in New York, Ohio, Wisconsin, Missouri, Kansas, and Tennessee.

MACROSTELES BINOTATUS (Sahlberg)

(Fig. 4, *M, N*)

Limotettix binotata Sahlberg, Notiser ur Sallsk. 12: 242, 1871.
Cicadula suffusa Osborn, Maine Agr. Expt. Sta. Bull. 238: 146, 1915.

Allied to *variatus*, but with two prominent black spots on vertex, together with two additional small spots between ocelli and eye. Greenish yellow with black sutural lines. Length 5 mm, width 1.2 to 1.3 mm.

Vertex slightly angular in front.

This species is distinctly characterized by the prominent black spots on the vertex and the bright orange-red coloration of the vertex and frons.

In the female the last ventral segment is slightly emarginate. Only females have been examined. Determined specimens of *Cicadula binotata* from Europe agree exactly with *C. suffusa*.

Collected in Maine, Illinois, and Ontario, as reported by Osborn.

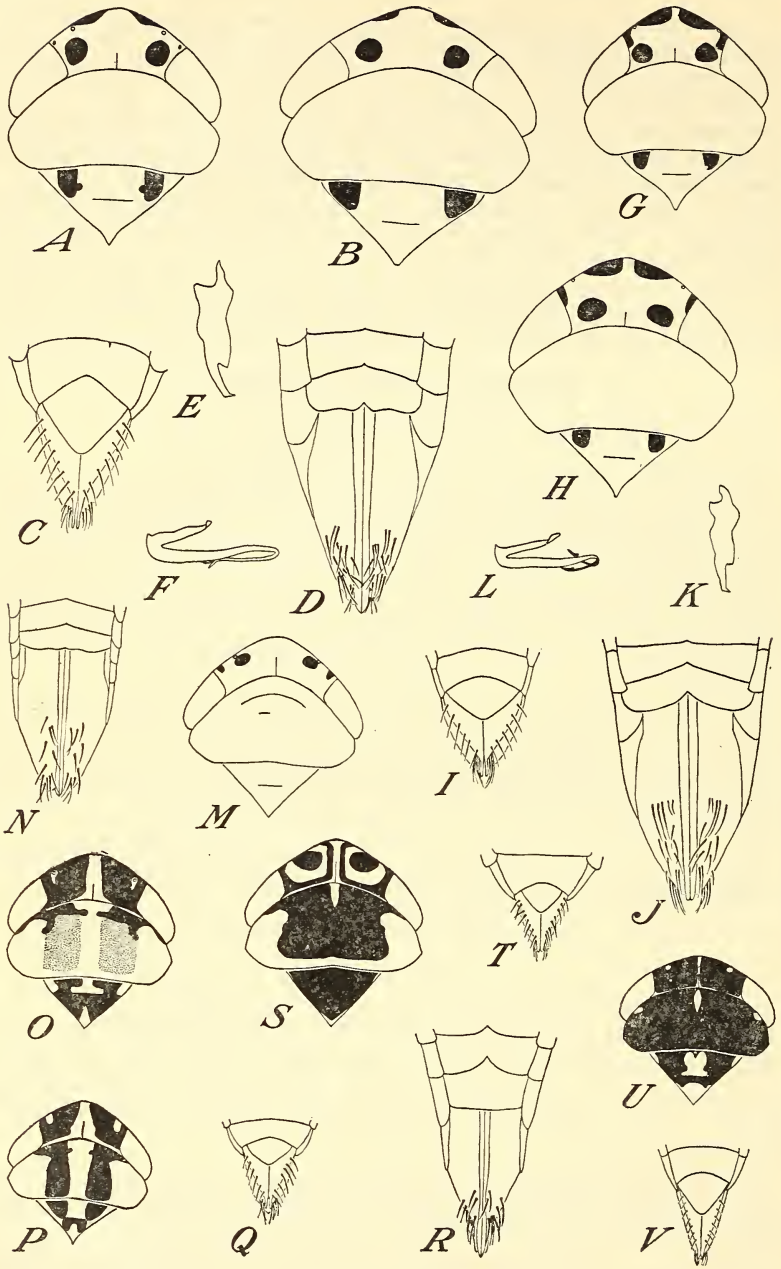

FIGURE 4.—External and internal details of *Macrosteles* spp.: *A*, Male head and thorax, *B*, female head and thorax, *C*, male genitalia, *D*, female genitalia, *E*, style, internal male genitalia, and *F*, aedeagus, internal male genitalia, of *M. variatus*; *G*, male head and thorax, *H*, female head and thorax, *I*, male genitalia, *J*, female genitalia, *K*, style, internal male genitalia, and *L*, aedeagus, internal male genitalia, of *M. lepidus*; *M*, female head and thorax, and *N*, female genitalia, of *M. binotatus*; *O*, female head and thorax, *P*, male head and thorax, *Q*, male genitalia, and *R*, female genitalia, of *M. borealis*; *S*, male head and thorax, and *T*, male genitalia, of *M. ungae*; *U*, male head and thorax, and *V*, male genitalia, of *M. osborni*.

MACROSTELES UNGAE (Ashmead)

(Fig. 4, *S*, *T*)

Cicadula ungae Ashmead, Harriman, Alaska Exped. 8: 134, 1904.

Dirty-yellow species 4 to 5 mm long.

Vertex somewhat angulate. Vertex with two black spots near anterior margin, band of black along posterior margin, between ocelli and eyes, and bordering both sides of median line. Pronotum and scutellum mostly black. Elytra smoky.

Male valve somewhat elongate.

Only males examined and none dissected. Compared with female type in the United States National Museum.

Collected in Maine and Alaska.

MACROSTELES BOREALIS (Dorst)

(Fig. 4, *O*, *P*, *Q*, *R*)

Cicadula borealis Dorst, Jour. Kans. Ent. Soc. 4: 45, 1931.

A tawny-yellow species resembling *slossoni* in coloration but more robust. Vertex less angulate than in *variatus*. Length 3.5 to 4.5 mm.

Vertex black with wide yellow median line continuing from margin of vertex across pronotum and scutellum. Pale ocelli very conspicuous. Elytra smoky.

Male valve large and broad. Female last ventral segment slightly convex on posterior margin.

No specimens dissected for examination of internal male genitalia.

Collected in Washington and British Columbia.

MACROSTELES OSBORNI (Dorst)

(Fig. 4, *U*, *V*)

Cicadula osborni Dorst, Jour. Kans. Ent. Soc. 4: 45, 1931.

A black species with vertex broadly rounding. Vertex black except for yellow ocelli and yellow median lines. Pronotum and scutellum mostly black. Elytra black, somewhat lighter toward tip. Length 4 mm, width 1.2 mm.

Male valve extra large with rounding apex.

Only males examined; none dissected.

Collected in Alaska.

MACROSTELES FASCIFRONS (Stål)

Thamnotettix fascifrons Stål, Stettin. Ent. Ztg. 19: 194, 1858.
Cicadula warioni Lethierry, Bull. Soc. Hist. Nat. Metz (2) 15: 127, 1878.

A pale-brown species with six spots on the vertex. Vertex not so much produced as in *lineatifrons*. Length 3.5 to 4.5 mm.

Vertex with three pairs of black spots, one near posterior margin, one on anterior margin, and one between. One small black spot on median margin of each eye. One or two pairs of black spots on front just below anterior margin of vertex. Pronotum and scutellum with some brown markings. Elytra dirty brown.

Internal male genitalia with large aedeagus that ends in two fingerlike processes that fold back on ventral side of aedeagus but are not parallel with shaft.

Reported on *Juncus* in Washington, California, and Alaska.

No specimens of this species have been examined.

MACROSTELES DIVISUS (Uhler)

(Fig. 5. *A, B, C, D, E, F, G*)

Jassus divisus Uhler, U. S. Dept. Int., Geol. and Geog. Survey Bull. 3: 472, 1877.
Cicada sexnotata Fallén, K. Svenska Vetensk. Akad. Nya Handl. 27: 34, 1806 (American records cited in error).
Cicadula quadrilineatus Forbes, 14th Rept. State Ent. Ill., p. 68, 1884.

Resembling *variatus* but smaller. Length 3.5 to 4.5 mm, width 1 to 1.2 mm.

A yellowish-green species with six spots on vertex.

Vertex produced, broadly rounding with front. Pronotum with lateral margins very short.

Vertex with three pairs of black spots, one near posterior margin, one on anterior margin, and one pair between the other pairs; black spot on margin of each eye. Elytra smoky on apical third.

Male valve large, obtusely rounding at apex. Female last ventral segment truncate on posterior margin.

Internal male genitalia with somewhat blunt toe on foot of style, with large aedeagus terminating in two fingerlike processes which are compressed dorsoventrally, gradually widening first two-thirds of distance, and then narrowing to a point.

Macrosteles divisus is variable in intensity of color markings on the vertex and in size. In some specimens the spots on the vertex are prominent and in others the markings are very faint. The examination of a large series did not show a clear line for specific or varietal separation.

This seems to be the most important species of the genus in that it transmits the disease of yellows to celery, lettuce, and aster. In the eastern part of the United States it is of economic importance as a feeder on oats, timothy, corn, potato, and pasture grass. It is frequently collected on grass from Maine to California and from Minnesota to Texas, and in Alaska and Canada.

Cicadula quadrilineatus Forbes appears to be identical with *divisus*.

H. H. Severin, of the University of California, sent a series of specimens the elytra of which were exceedingly long compared with those of other specimens, but no internal genitalic differences could be found.

American records of *sexnotatus* are apparently based on misidentification of *divisus*. Specimens of determined *sexnotatus* from different parts of Europe, including the type locality, have been examined, and they are not the same as the so-called *sexnotatus* or the species *divisus* in North America. In a previous publication (*2*) the matter of the correct name for the common species found in this country was discussed. Additional material has since been examined, and the former conclusions have been verified. The findings of Ribaut (*18*) in 1927 add further proof as to the correct determination of *sexnotatus*. The European species appears to be

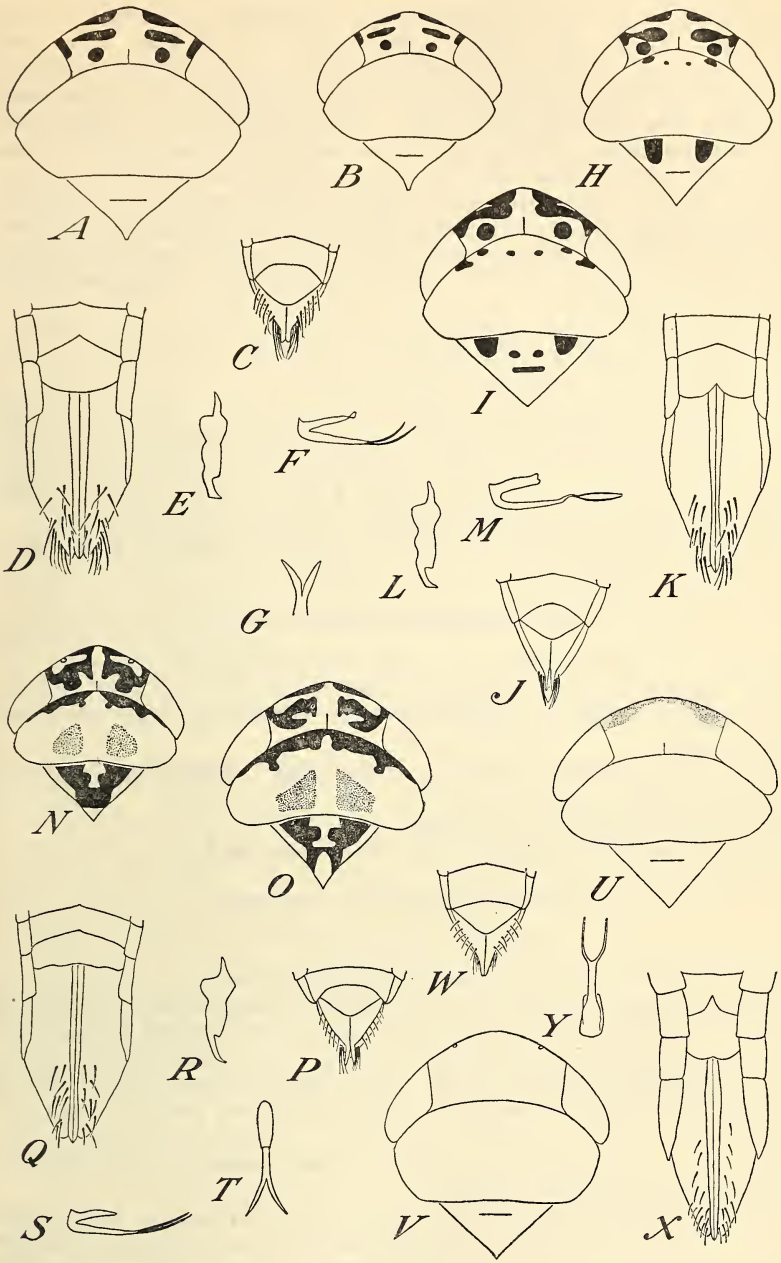

FIGURE 5.—External and internal details of *Macrosteles* spp.: *A*, Female head and thorax, *B*, male head and thorax, *C*, male genitalia, *D*, female genitalia, *E*, style, internal male genitlia, *F*, aedeagus, internal male genitalia (lateral view), and *G*, same (dorsal view), of *M. divisus*; *H*, male head and thorax, *I*, female head and thorax, *J*, male genitalia, *K*, female genitalia, *L*, style, internal male genitalia, and *M*, aedeagus, internal male genitalia, of *M. sexnotatus*; *N*, male head and thorax, *O*, female head and thorax, *P*, male genitalia, *Q*, female genitalia, *R*, style, internal male genitalia, *S*, aedeagus, internal male genitalia (lateral view), and *T*, same (dorsal view), of *M. slossoni*; *U*, male head and thorax, *V*, female head and thorax, *W*, male genitalia, *X*, female genitalia, and *Y*, aedeagus, internal male genitalia, of *M. viridi-griseus*.

more stoutly built, and the spots near the posterior margin of the vertex are larger and more rounded than in *divisus*. The last ventral segment of the female of *sexnotatus* has a distinct notch on the posterior margin, and the internal male genitalia of the European and American forms do not agree. The aedeagi are of about the same size, but in the European species a distinct bend occurs at the apex of the shaft where the two fingerlike processes arise.

Uhler (*23*) in 1877 described a form closely related to *Cicadula sexnotata* and applied the specific name *divisa*. No types can be found at the present time. Gillette and Baker (*5*) in 1895 reported regarding *divisa:* "This species will probably prove to be, at the most, but a form of *C. 6-notata*."

After an examination of the internal male genitalia of specimens from the type locality and other localities that conformed to the *C. divisus* description, it seems clear that this was a name given to what has been called the dark form of *sexnotatus*. Since the latter name cannot be applied to American specimens, *Macrosteles divisus* becomes the name for what has hitherto in the United States been called *C. sexnotata*. True *sexnotatus* Fall. does not occur in this country, so far as can be determined from material examined.

Drawings of *Macrosteles sexnotatus* (Fall.) are shown in figure 5, *H*, *I*, *J*. *K*, *L*, and *M*.

MACROSTELES LINEATIFRONS (Stål)

Thamnotettix lineatifrons Stål, Stettin. Ent. Ztg. 19: 195, 1858.

A tawny-yellow species with six black markings on vertex and one between ocelli and eye. Length 4 mm. Vertex strongly produced. Elytra smoky.

Female last ventral segment with broad, rounding notch on posterior margin.

Reported in Quebec and Alaska.

No specimens of this species have been examined.

MACROSTELES SLOSSONI (Van Duzee)

(Fig. 5, *N*, *O*, *P*, *Q*, *R*, *S*, *T*)

Cicadula slossoni Van Duzee, Canad. Ent. 25: 281, 1893.

A blackish-green species with the eight spots on vertex somewhat convergent, allied to *divisus* but with more coloring and usually with smoky patches on elytra. Length 3.3 to 4 mm, width 0.8 to 1 mm.

Vertex bluntly angulate, with three pairs of spots on vertex and one next each eye, convergent. Black marking on pronotum and scutellum.

Male valve large and broad. Female last ventral segment slightly emarginate on posterior margin.

Internal male genitalia with foot of style ending in blunt point at toe, with stout aedeagus terminating in two spearlike processes which are compressed dorsoventrally and are one-third shorter than shaft.

Collected on swamp grass in Maine, New Hampshire, New York, Pennsylvania, North Carolina, Ohio, Wisconsin, British Columbia, Ontario, and Nova Scotia.

MACROSTELES PALLIDUS (Osborn)

(Fig. 6, *M, N, O, P*)

Cicadula pallida Osborn, Maine Agr. Expt. Sta. Bull. 238: 146, 1915.

A small, light-gray species with orange-yellow vertex and face without distinct spots or bars. Venter black. Length 3.2 to 3.5 mm, width 1 to 1.1 mm.

Vertex obtusely angulate. Elytra hyaline, veins distinct.

Male valve large, rounded posteriorly. Female last ventral segment slightly emarginate on posterior margin.

No specimens were dissected.

Collected in Maine by Herbert Osborn.

MACROSTELES OBSOLETUS (Dorst)

(Fig. 6, *Q, R, S, T, U, V*)

Cicadula obsoleta Dorst, Jour. Kans. Ent. Soc. 4: 42, 1931.

Allied to *pallidus* but with two spots on anterior margin of vertex. Length 3.2 to 3.5 mm, width 0.8 to 1 mm.

Vertex obtusely angulate. Elytra veins distinct. Venter yellow.

Male valve large. Female last ventral segment slightly emarginate on middle of posterior margin.

Internal male genitalia with moderately long aedeagus terminating in two short fingerlike processes, with an additional branch on inner margin of each process.

Collected in Kansas and Texas.

MACROSTELES VIRIDI-GRISEUS (Edwards)

(Fig. 5, *U, V, W, X, Y*)

Cicadula viridi-grisea Edwards, Ent. Monthly Mag. 60: 54, 1924.

Allied to *divisus* but with color pattern usually distinct. Frons with wide black hand. Length 3.5 to 4.2 mm, width 0.9 to 1 mm.

Vertex broadly rounding, with front tawny yellow, with wide brown band in female and black band in male. Often with distinct spots on vertex. Elytra tawny yellow.

Male valve large and somewhat elongate. Female last ventral segment concave on posterior margin.

Internal male genitalia having aedeagus with large shaft terminating in two fingerlike processes which form a .

James Edwards described this species from England.

Two specimens collected by W. J. Brown at Natashquan, Quebec, August 7, 1929, and 30 specimens collected by W. W. Perrett at Hopedale, Labrador, August 8, 1926, were sent to the author in the collection of G. Stuart Walley, of Ottawa, Canada.

This is the first record of this species being collected in North America. At the time he described the species, Mr. Edwards had collected it in numbers in four counties.

MACROSTELES WILBURI, new species

(Fig. 6, *W, X, Y, Z, Z–1, Z–2*)

A yellow species with two oblong black spots on anterior margin of vertex. Allied to *pallidus* but with less produced vertex. Length 3.2 to 3.5 mm, width 0.9 to 1 mm.

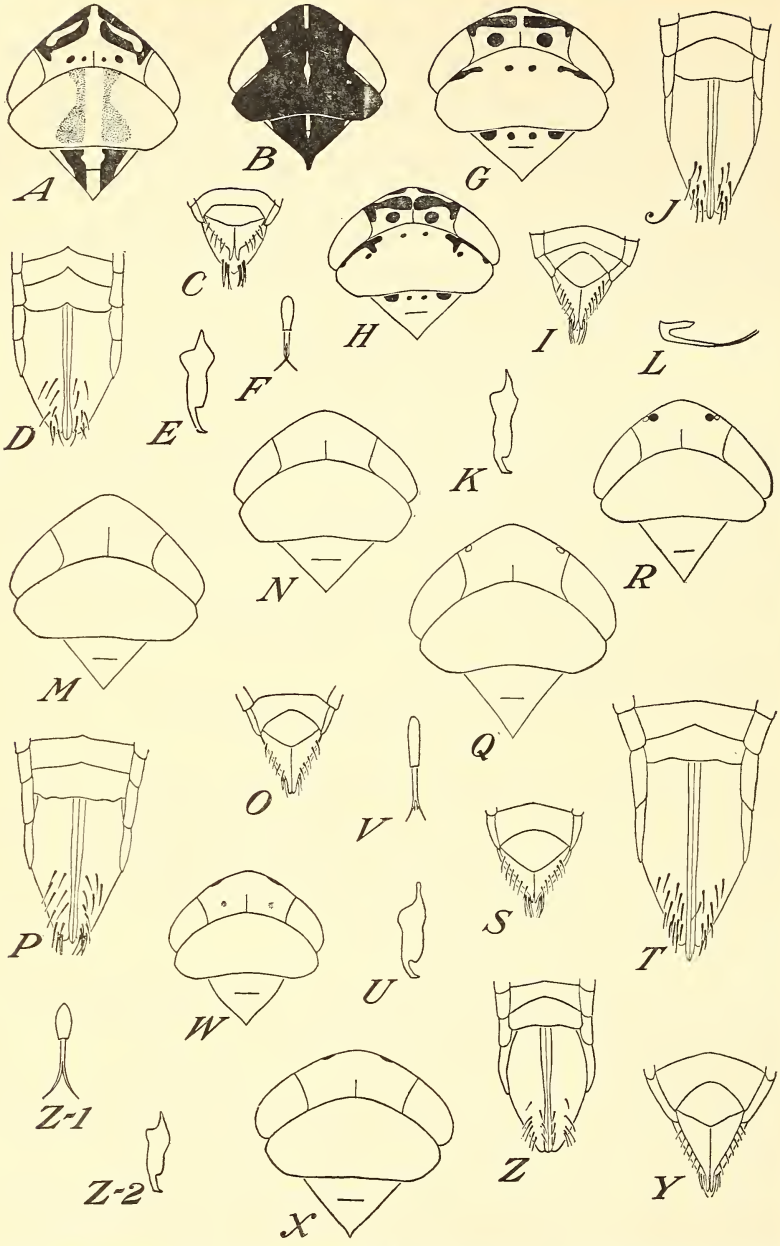

FIGURE 6.—External and internal details of *Macrosteles* spp.: *A*, Female head and thorax, *B*, male head and thorax, *C*, male genitalia, *D*, female genitalia, *E*, style, internal male genitalia, and *F*, aedeagus, internal male genitalia, of *M. potorius*; *G*, female head and thorax, *H*, male head and thorax, *I*, male genitalia, *J*, female genitalia, *K*, style, internal male genitalia, and *L*, aedeagus, internal male genitalia, of *M. scriptus*; *M*, female head and thorax, *N*, male head and thorax, *O*, male genitalia, and *P*, female genitalia, of *M. pallidus*; *Q*, female head and thorax, *R*, male head and thorax, *S*, male genitalia, *T*, female genitalia, *U*, style, internal male genitalia, and *V*, aedeagus, internal male genitalia, of *M. obsoletus*; *W*, male head and thorax, *X*, female head and thorax, *Y*, male genitalia, *Z*, female genitalia, *Z–1*, style, internal male genitalia, and *Z–2*, aedeagus, internal male genitalia, of *M. wilburi*.

Vertex broadly rounding to front, one-fourth to one-fifth longer on middle than next to eye, between two and three times as wide as long. Sometimes two small indentations near posterior margin of vertex. Pronotum short; width exceeding twice the length; anterior margin broadly convex; lateral margins distinctly shorter than humeral margin; posterior margin nearly straight. Scutellum equal to vertex in width.

General color yellow. Vertex yellow, with two distinct oblong black spots on anterior margin. Occasionally a brown spot between ocelli and eye. Pronotum yellow. Scutellum yellow with light-brown transverse line. Elytra hyaline. Arcs on front usually brown but often pale yellow. Venter yellow.

Male valve large, triangular; outer margin of plates with white spines. Female last ventral segment shorter than preceding segment; two lateral emarginations on posterior margin or middle; pygofer about equal in length to black ovipositor, white spines on apical third apparently in two distinct rows.

Internal male genitalia with style similar to that of *divisus*, but smaller. Aedaegus longer than style; shaft moderately elongate, terminating in two short fingerlike processes which are compressed dorsoventrally.

Species named after Donald A. Wilbur, of Kansas State College.

Collected on upland prairie grass, a mixture of small bluegrass and big grass with the small bluegrass predominating. Twenty-four specimens collected near Manhattan, Kans., July 15, 1930, by Donald A. Wilbur.

Holotype and allotype deposited in the United States National Museum (Cat. no. 51879).

Paratypes deposited in collection of Donald A. Wilbur, Kansas State College; in the Snow collection, University of Kansas; in the United States National Museum; and in the collection of the author.

MACROSTELES POTORIUS (Ball)

(Fig. 6, *A, B, C, D, E, F*)

Cicadula potoria Ball, Canad. Ent. 33: 346, 1900.

Smaller then *slossoni* and with more pointed vertex. Length 2 to 2.5 mm, width 0.6 to 0.8 mm.

Vertex nearly right-angled at apex, usually black with two white oblique spots on each side and a central whitish strip that tends posteriorly, but sometimes totally black. Pronotum and scutellum generally heavily marked with black. Elytral nervures smoky.

Male valve uniformly rounded behind. Female last ventral segment slightly emarginate in middle on posterior margin.

Internal male genitalia with small aedeagus terminating in two small branches which are crossed and compressed dorsoventrally.

Collected on *Juncus* in Maine, New York, and Iowa.

MACROSTELES SCRIPTUS (DeLong)

(Fig. 6, *G, H, I, J, K, L*)

Cicadula scriptus DeLong, Jour. N. Y. Ent. Soc. 32: 67, 1924.

A minute species resembling *divisus* in coloration but much smaller and with distinct markings. Two distinct spots near anterior margin of pronotum. Length 2 to 2.5 mm, width 0.8 to 0.9 mm.

Vertex arcuately produced. Tawny-yellow species with three rows of two spots and a spot between each ocellus and eye. Pronotum and scutellum marked with black. Elytra smoky green. Venter yellow.

Male valve large and rounding at apex. Female last ventral segment slightly convex on posterior margin.

Internal male genitalia with small aedeagus terminating in two small fingerlike processes.

Collected on *Eleocharis ochreata* in low wet places in Florida by D. M. DeLong.

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